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Government inter-organizational information sharing initiatives: Understanding the main determinants of success

J. Ramon Gil-Garcia [a,b], Djoko Sigit Sayogo [c,d]

[a] University at Albany, State University of New York, 187 Wolf Road, Suite 301, Albany, NY 12205, USA
[b] Centro de Investigacion y Docencia Economicas (CIDE), Carretera México-Toluca 3655, Col. Lomas de Santa Fe, 01210 México, D.F., Mexico
[c] Center for Technology in Government, University at Albany, 187 Wolf Road, Suite 301, Albany, NY 12205, USA
[d] University of Muhammadiyah at Malang, Jl. Raya Tlogo Mas No.246, Jawa Timur 65144, Indonesia

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ABSTRACT

In an era of wicked social problems, a smarter, more responsive, more efficient governance structure is necessary to take advantage of the enormous capability of the public to congregate, interact, and collaborate in finding solutions to intricate sociotechnical challenges. The bedrock for such a structure is open and shared information; the key to opening and sharing information lies in interagency information sharing and integration. With the objective to supplement previous research based on rich qualitative data, this study systematically identifies and tests some important determinants of the success of inter-organizational collaboration and information sharing initiatives through quantitative empirical analysis. Based on a national survey of government managers from two policy domains (criminal justice and public health) in the United States, this study found four statistically significant predictors of inter-organizational information sharing success. From those, we found compatibility of technical infrastructure and formally assigned project managers as the two most important predictors explaining the success of inter-organizational information sharing initiatives.

1. Introduction

Advancements in information and communication technologies (ICTs) have the potential to create substantial transformation in society by fostering the ability to connect and collaborate with diverse social actors. Driven by their interests, values, and needs, individuals use and shape the capabilities provided by technology (Castells, 2005) to find solutions for community challenges and social problems (Johnston & Hansen, 2011). This drive to use technology for the common good has risen in the last few decades as the social problems we face have become even more complex, what some called "wicked" (O'Toole, 1997). Johnston and Hansen (2011) argue that to augment the enormous collective capabilities of individuals to organize, interact, and govern in order to overcome complex social challenges, they need a smart government infrastructure, which is both more responsive and more efficient than our current government paradigms.

Scholars have argued that the key factors for creating a smart government that can handle complexity and uncertainty are coordination, continued engagement, access to open data, and shared information (Gil-Garcia, 2012b; Gil-Garcia, Helbig, & Ojo, 2014; Scholl & Scholl, 2014). Thus, the bedrock for smart governance infrastructure is shared, timely, and actionable information (Scholl & Scholl, 2014; Johnston & Hansen, 2011). Consequently, opening and sharing information is vital for smart governance infrastructure (Johnston & Hansen, 2011). Furthermore, the linchpin for opening and sharing data and information lays in interagency information sharing and integration (Dawes, 2012) because it is regarded as a practical and efficient tool for joint problem solving (Dawes, 1996; Klievink & Janssen, 2009; Tapscott & Caston, 1993).

Effective inter-organizational information sharing has been associated with various benefits within technical, organizational, and political spheres (Dawes, 1996; Gil-Garcia, Chengalur-Smith, & Duchessi, 2007). Inter-organizational information sharing improves efficiency by reducing the cost from shared development (Dawes, 1996; Kwon, Pardo, & Burke, 2009), pooling resources and shared technical expertise (Fedorowicz, Gogan, & Williams, 2007; Gil-Garcia & Pardo, 2005a, 2005b), and reducing redundancy in terms of multiple data collection efforts and data storage (Dawes, 1996). Inter-organizational information sharing can also improve public service delivery by facilitating collaboration and coordination across multiple agencies (Zheng, Yang, Pardo, & Jiang, 2009).

In addition, inter-organizational information sharing often relies on the collaborative work of diverse actors from different organizations performing different roles at distinct times. Within this complex environment, inter-organizational information sharing initiatives face numerous challenges. Some studies of inter-organizational information sharing focus on understanding those challenges (for examples see

E-mail addresses: jgil-garcia@ctg.albany.edu (J.R. Gil-Garcia), dsayogo@ctg.albany.edu, dsayogo@umm.ac.id (D.S. Sayogo).

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Gharawi & Dawes, 2010; Gil-Garcia, Chun, & Janssen, 2009; Pardo, Gil-Garcia & Burke, 2009; Pardo & Tayi, 2007; Gil-Garcia, Chengalur-Smith, & Duchessi, 2009). Other studies take on the discussion of challenges and then also propose success factors of interagency information sharing (Dawes, Cresswell, & Pardo, 2009; Gil-Garcia & Pardo, 2005a, 2005b; Yang & Maxwell, 2011).

This study aims to provide quantitative empirical examinations of the relationships among various factors that influenced the success of inter-organizational information sharing initiatives in the public sector. The study addressed two research questions: (1) What factors contribute to the success of inter-organizational information sharing initiatives? (2) Among the significant determinants, which factors are more important to the success of inter-organizational information sharing initiatives?

Literature in the field of Information Science has discussed the issue of success factors for inter-organizational information systems (IOS) for a long time. Within the private sector, studies have been conducted to empirically test various success models through quantitative examination of inter-organizational systems, including Delone and McLean's (1992) proposed success model (see IIvari, 2005; Wu & Wang, 2006; Wang, 2008; Wang & Liao, 2008). Likewise, there have been extensive and rich discussions of both the challenges and success factors of inter-organizational information sharing in the public sector, but mostly from qualitative perspectives. Therefore, this study complements the findings from previous inter-organizational information sharing studies by using quantitative analysis.

The data we analyzed in this study is from a national survey conducted by the Center for Technology in Government to understand the challenges and success factors of inter-organizational information sharing initiatives from the perspective of public officers, consultants, and NGOs involved in information sharing initiatives. This paper focuses its discussion on the determinants of information sharing at the inter-organizational level and we do not discuss factors affecting interpersonal information sharing.[1]

This paper is organized in six sections, including the foregoing introduction. The second section discusses the determinants of inter-organizational information sharing from previous studies, including our hypotheses and preliminary research model. The third section outlines the data collection, the operationalization of the variables, and the analysis techniques. Section four presents the results of our analysis and section five discusses the main findings. Finally, section six provides some concluding remarks and suggests areas for future research within this topic.

2. Inter-organizational information sharing success in the public sector

This section describes the main determinants of inter-organizational information sharing identified in the literature and groups them in broad categories to organize and better understand them. As argued by Dawes et al. (2009), the need to overcome complex social problems that are beyond the capabilities of a single organization or jurisdiction requires inter-organizational collaboration and sharing of information. Depending on the complexity of the problems and the organizations involved, cross-boundary information sharing gradually increases from intra-organizational, to inter-organizational, to inter-governmental (Gil-Garcia & Pardo, 2005a, 2005b; Yang & Wu, 2013). Following this logic, in this paper we use the term inter-organizational information sharing to refer to the cross-boundary information sharing that takes place among multiple organizations as opposed to among multiple units within the same organization.

To frame our discussion of the success factors of inter-organizational collaboration and information sharing, in this study we adopt the concept of inter-organizational information integration from Gil-Garcia, Pardo, and Burke (2010). They define inter-organizational information sharing as a multi-dimensional concept with four key components: trusted social networks, shared information, integrated data, and interoperable technical infrastructure (Gil-Garcia et al., 2010). They further view inter-organizational information sharing as an essential element underlying the socio-technical phenomenon of inter-organizational collaboration. Thus, we argue that the success of inter-organizational information sharing is affected by multiple socio-technical determinants. Andersen and Dawes (1991) propose a framework to understand the determinants and relevant aspects of government information technology initiatives from a socio-technical perspective. Their framework classifies the determinants into three inter-related categories: technology, organization, and policy. These three categories reside within larger contexts, such as the economy or political environment (Andersen & Dawes, 1991).

Enriching the framework proposed by Gil-Garcia et al. (2010) and Andersen and Dawes (1991); Yang and Maxwell (2011) further identify antecedents of information sharing from organizational perspectives. They argue that there are three major components supporting the success of information sharing: a) external and environmental factors, such as government regulations, law or politics; b) organizational factors, such as trust or culture; and c) social or interpersonal relations (Yang & Maxwell, 2011). Additionally, as suggested by Pardo, Nam, and Burke (2011), success in inter-organizational information sharing also depends on the governance, strategic management, information policy, and technological readiness underlying the sharing. Technological readiness implies many different aspects; foremost are interoperable infrastructure (Pardo et al., 2011) and the need for standardization to support interoperability (Reichman, Jones, & Schildhauer, 2011).

Assessing the challenges and success factors of inter-agency data sharing in England, Sanderson, Banks, Deakin, and Udagawa (2015) found three major factors as determinants of inter-agency data sharing, in the forms of (1) social and organizational networks, (2) technical considerations, and (3) legal considerations. As also succinctly argued by Yang (2011), factors affecting the success of inter-organizational information sharing can be categorized into four dimensions: technological, organizational, legislative, and contextual. Thus, based on the existing literature, it can be concluded that the key determinants to inter-organizational information sharing success can be grouped into seven categories: (1) information, (2) technology, (3) managerial, (4) organizational, (5) policy, (6) political, and (7) contextual. Following, we briefly describe and discuss each of these four categories of factors and group them into four clusters for presentation purposes.

2.1. Information and technology determinants

The growing role of technology in government is central to inter-organizational information sharing. These initiatives have achieved some promising benefits from the use of ICTs (Caffrey, 2000; Cresswell, Canestraro, Gil-Garcia, Pardo, & Schneider, 2004; Cresswell, Pardo, Thompson, et al., 2002; Dawes & Pardo, 2002; Dawes, 1996; Hale & McNeal, 2011). However, though technology is an important factor for inter-organizational information sharing, the expectation that technology creates new information sharing and integration capability often remains hype, but only comes to fruition in a few cases (Pardo, Gil-Garcia, & Burke, 2009).

The technology determinants typically involve the availability of technical infrastructure, interoperable standards, and technological compatibility. Technological compatibility and interoperability substantially affect the performance of inter-organizational information sharing initiatives; therefore, incompatibility between the technical resources of participating organizations represents a major challenge (Pardo et al., 2011; Sanderson et al., 2015). Ensuring technological compatibility requires the development of standards, platform and application interoperability, metadata, and the use of algorithms (Bekkers, 2009;

[1] For a discussion of interpersonal information sharing, see Yang and Maxwell (2011).

Ferro & Sorrentino, 2010; Gil-Garcia & Pardo, 2005a, 2005b; Gottschalk, 2009; Guijarro, 2007; McDermott, 2010; Murray & Hsieh, 2008; Pardo, Cresswell, & Burke, 2004; Pardo & Tayi, 2007; Scholl & Klischewski, 2007; Schooley & Horan, 2007). Furthermore, achieving interoperability requires standardization and the creation of provenance of disparate and heterogeneous data and information (Reichman et al., 2011; Michener, 2006). Standardization and provenance are also crucial to ensure inter-agency data sharing (Sanderson et al., 2015). In term of information determinants, previous studies have found that information security and protection significantly influence use within information sharing initiatives. Concerns about information security create significant challenges in embracing and implementing inter-organizational information sharing (Yang & Wu, 2013). For instance, as argued by Batista and Cornock (2009), combining data and information from different sources could enable re-identification of personal data, thus running the risk of security and privacy infringements. This problem accentuates the need for better information policies and security to ensure the protection of sensitive data (Sanderson et al., 2015). We propose the following hypotheses:

Hypothesis 1. Information determinants significantly influence the success of inter-organizational information sharing initiatives.

Hypothesis 2. Technology determinants significantly influence the success of inter-organizational information sharing initiatives.

2.2. Organizational and managerial determinants

A variety of managerial factors in organizational and inter-organizational contexts could affect inter-organizational information sharing initiatives. From the organizational perspective, fundamental components of the organizational settings (i.e., resources, structure, leadership, strategy, and process) could contribute to the success of these initiatives. From the inter-organizational perspective, limited availability of financial resources is one of the most apparent reasons for failure in information sharing initiatives. Size and overall resource levels are among the major determinants of inter-organizational information sharing success (Yang & Maxwell, 2011). Without financial resources, it will be extremely difficult to initiate and sustain collaboration that underlies sharing knowledge and information (Gharawi & Dawes, 2010; Sanderson et al., 2015).

Governance and organizational structure are other important determinants of the success of inter-organizational information sharing (Luna-Reyes, Gil-Garcia, & Cruz, 2007; Luna-Reyes & Gil-Garcia, 2011; Sayogo & Gil-Garcia, 2015). Structural variables such as centralization, formalization, and other bureaucratic characteristics influence communication channels and information flows within an organization or between organizations (Fountain, 2001; Gil-Garcia, 2005; Gil-Garcia, 2012a). Inter-organizational information sharing involves collaboration of participants from various organizations with different, and often conflicting, agendas and goals (Dawes et al., 2009; Cresswell et al., 2004; Cresswell et al., 2002). Success is frequently tied to the governance structure of the initiative, which takes into account the interdependencies of knowledge and information between the various participants in the project (Markus & Bui, 2012; Pardo, Gil-Garcia, & Burke, 2008; Sayogo & Gil-Garcia, 2015).

Leadership also has a significant influence on inter-organizational information sharing (Demercivi, Thompson, & Bodor, 2004; Eglene, Dawes, & Schneider, 2007; Gil-Garcia et al., 2010). Leadership can be manifested through various mechanisms. For instance, positive top management support, attention, and active engagement have been identified as enablers of these initiatives (Jarvenpaa & Ives, 1991; Murray & Hsieh, 2008; Reddick & Frank, 2007). Another example is the importance of the project manager's role in balancing the need for flexibility in implementing the ICT project with the need to restrict the participants' behavior to adhere to the development schedule and processes (Hulstijn et al., 2011).

In addition, previous studies have recognized the importance of the involvement of external consultants (Kaarst-Brown, 1999), particularly for information technology projects in the private sector (Ginzberg, 1981). Studies examining enterprise resource planning (ERP) implementation recognize the importance of external consultants for the success of the ERP implementation (e.g., Motwani, Mirchandani, Madan, & Gunasekaran, 2002). There are some indications that the involvement of external consultants is also one of the main factors influencing inter-agency information sharing (Pardo, et al., 2009). From the perspective of project implementation for Information and Communication Technologies for Development (ICT4D), Njihia and Merali (2013) argued for the need to use external consultants for public sector ICT, especially to ensure that the possible disruptive impact of technological innovation is controlled and to attract attention to new ideas about structural and cultural organizational changes. In the case of Qatar's e-service delivery implementation, external consultants help supplement the project team when the needed expertise was lacking inside the organization (El-Haddadeh, Weerakkody, & Al-Shafi, 2013). We propose the following hypotheses:

Hypothesis 3. Managerial determinants significantly influence the success of inter-organizational information sharing initiatives.

Hypothesis 4. Organizational determinants significantly influence the success of inter-organizational information sharing initiatives.

2.3. Political and institutional determinants

The legal, regulatory, and policy frameworks in which government agencies operate clearly influence information sharing and integration. In fact, this institutional context could be seen as a basic condition for inter-organizational information sharing (Dawes, 1996; Landsbergen & Wolken, 1998). Multi-organizational collaboration in the public sector requires institutional legitimacy, which commonly begins with law or regulation and is strengthened by sponsorship from recognized authority figures or formal relationships among participants (Dawes & Prefontaine, 2003).

Enabling legislation as a bolster for institutional legitimacy has a dual effect. Legislation can affect inter-organizational information sharing initiatives by creating governance conditions for better information sharing among different agencies. Legal considerations are also important for governing the data and providing information protection, particularly when sensitive data or information is involved (Sanderson et al., 2015). On the other hand, most government activities are defined and funded through legislation that creates specific programs and assigns responsibility for those programs to specific agencies, potentially limiting the opportunities for collaboration.

Institutional legitimacy can also be derived from the involvement of top executives in the project. Pardo, Gil-Garcia, and Burke (2009) argue that executive involvement affects governance structures in inter-organizational information sharing initiatives. The governance structure in turn provides institutional legitimacy for the managers or personnel in collaboration for inter-organizational information sharing (Pardo, Gil-Garcia, & Burke, 2009). In addition, how the executives exercise their authority influences the building of mutual respect and trust among the participants, which then influence the success of inter-organizational information sharing. Lack of or improper use of authority creates distrust and frustration among organizations involved in the effort (Pardo et al., 2006; Gil-Garcia et al., 2009).

The political environment around government agencies exerts strong institutional and situational influences on information sharing and integration initiatives (Pardo, Gil-Garcia, & Burke, 2009). Dawes, Gharawi, and Burke (2011) view political distance (the gap, divergence, and conflict in political interests, political philosophies, points of view,

and agendas) between the participating organizations as a contextual factor influencing organizational participation in information sharing. When political distance exists, participants are less likely to establish and sustain their engagement in a network for information and knowledge sharing. We propose the following hypotheses:

Hypothesis 5. Institutional determinants significantly influence the success of inter-organizational information sharing initiatives.

Hypothesis 6. Political determinants significantly influence the success of inter-organizational information sharing initiatives.

2.4. Contextual determinants

Finally, the three types of determinants of inter-organizational information sharing are embedded in the context in which government organizations operate. This environment also affects the success of inter-organizational information sharing initiatives. General socioeconomic and political environments, in particular, place constraints or promote these initiatives (Fedorowicz et al., 2007; Pardo et al., 2004; Wang, Song, Hamilton, & Curwell, 2007; Yang & Maxwell, 2011). The success of inter-organizational information sharing also depends largely on the existence of trust and incentives as important factors that influence effective collaboration (Pardo et al., 2008). The nature of these incentives—ranging from institutional to financial—influences the success of inter-organizational information sharing initiatives (Gil-Garcia & Pardo, 2005a, 2005b; Dawes et al., 2009; Pardo et al., 2006). A culture that appreciates the value of collaboration provides informal incentives for information sharing; the absence of such culture engenders the need for other incentives, such as financial motivation, to encourage information sharing (Dawes et al., 2009). The other key to effective collaboration is creating a trusted social network that sustains the involvement of diverse participating organizations (Pardo, Burke, Gil-Garcia & Guler, 2009; Pardo et al., 2008). Overall, social, economic, and political contexts have been found as relevant to information sharing success. We propose the following hypothesis:

Hypothesis 7. Contextual determinants significantly influence the success of inter-organizational information sharing initiatives.

3. Research design and methods

This section briefly describes the research methods used in this study. It lists the models being tested and provides information about the context of the survey, the questions that were asked, and the variables that were used for this study.

3.1. Data and measurement

This study analyzes data from a national survey conducted by the Center for Technology in Government (CTG) in April 2008.[2] This paper could be seen as using secondary data, but since one of the authors was also involved in the initial development of the survey, which was based on the academic literature and previous qualitative analysis, the approaches are similar and several of the variables are the same or very good proxies of the ones conceptualized for this study. The original random-sample dataset consists of 173 responses from individuals involved in inter-organizational information sharing efforts, with the demographic distribution as shown in Table 1. After data cleaning, the analysis was based on 158–160 responses and about 7–8% of the responses are dropped from the analysis due to missing values. The majority of survey respondents work for local governments (56%), followed by state governments (29%). The majority of these respondents have positions as executives (35%) or program managers (35%). The proportion of male respondents was higher than female respondents by 16%. Almost all respondents have acquired some experience working in their respective field for at least one year, with only 3% of the respondents indicating that they had not yet acquired some experience at the time of the survey.

Table 1
The sample distribution.

	Categories	Proportion
Employment	Federal agencies	5%
	Local agencies	56%
	State agencies	29%
	Private entities	3%
	NGOs	4%
	Academics	1%
	Other (e.g., independent consultant)	2%
Position	Executive	35%
	IT manager	12%
	IT staff	1%
	Program manager	35%
	Program staff	10%
	Administrative staff	7%
Initiative's boundary	Across units	7%
	Across agencies at the same level of government	23%
	Across levels of government	33%
	Across one level of government with non-government organization(s)	7%
	Across multiple levels of government with non-government organization(s)	27%
	Other (e.g. multi-nationals)	3%
Primary initiative coordinator	Federal government	6%
	State government	61%
	Local government	25%
	Private entities	0%
	Non-profit organization	4%
	Other (e.g. council of government)	4%
Years of experience	0 years	3%
	1–5 years	39%
	6–15 years	45%
	16–25 years	10%
	>25 years	3%
Sex	Female	42%
	Male	58%

The set of explanatory variables[3] includes various factors: enabling legislation, regulatory framework, support from legislature, executive (elected official) involvement, nature of incentives, diversity of participating organizations, network governance structure, hierarchical governance structure, formally assigned project manager, availability of financial resources, the use of external consultants, interoperable standards, technical infrastructure, and information security. Except for regulatory framework and executive involvement, these variables are measured using a 7-point likert scale. The regulatory framework and executive involvement variables are both composite variables measured using the predicted score after running principal component analysis. As a measure of how closely related are a set of items as a group, Cronbach's Alpha is used to assess the reliability of the composite variables (Santos, 1999). The reliability of the composite of regulatory framework measured using Cronbach's Alpha is 0.926 and for executive involvement the value is 0.809. The value of Cronbach's Alpha for both variables is above the accepted cut-off value of 0.7, indicating that

[2] Since this is a theory testing effort, using older data should not be a problem, because the relationships among the variables are expected to be generalizable and stable over time. Therefore, the results of the hypothesized relationships are expected to be consistent using different data sets (not exactly the same, since each dataset is different, but highly consistent in magnitude and significance).

[3] For this paper, we use some of the variables provided in the survey conducted by the Center for Technology in Government and we created two new composite variables as explained in the text. The complete set of original variables can be consulted in the following publication: Pardo, Theresa A., J. Ramon Gil-Garcia, G. Brian Burke, and Ahmet Guler. (2009). *Factors Influencing Government Cross-Boundary Information Sharing: Preliminary Analysis of a National Survey*. Albany, NY: The Research Foundation of State University of New York.

these variables are reliable. The descriptive statistics of the explanatory variables are presented in Table 2.

The dependent variable of this study is the success of the inter-organizational information sharing initiatives. This variable measures the extent to which the respondents identified the initiative in which they were involved as a success. For the analysis, we included inter-agency information sharing initiatives only (initiatives with the participation of two of more organizations). The measurement of these variables ranges from 1 as indication of "not a success" to 7 as indication of "success to a great extent". Normally, seven-point scales can be considered as continuous variables and we follow that convention in this paper. In order to test the hypotheses described earlier, this study employs multivariate regression analysis.

3.2. Proposed models for empirical analysis

Drawing on previous research on the success factors of inter-organizational information sharing, and the qualitative analysis performed in preparation for the survey, this study proposes a series of factors that influence the success of inter-organizational information sharing initiative as depicted in Fig. 1. As proposed by Gil-Garcia et al. (2010), the importance of the four components[4] in conceptualizing interagency information sharing differ from initiative to initiative and the success of each initiative is affected by unique factors. For instance, Cresswell and Pardo (2001) argue that the convergence of policy and organizational factors are significant determinants of success in a digital government project. Thus, in certain interagency initiatives, certain variables have more significant roles than other. Using the factors identified in Fig. 1, with Gil-Garcia et al. (2010) and Cresswell and Pardo's (2001) arguments as the basis, we propose four models for quantitative testing. We specify the four models as follows: three models for testing the influence of each category of determinants, one model to test the simultaneous impact of the three categories of determinants, and one model to test the influence of convergence between legal/policy and organizational determinants.[5] Quantitatively testing these four models serves two functions: a) analyzing the proposition suggested in Gil-Garcia et al. (2010) and b) statistically testing the impact of adding independent variables to the magnitude of the coefficients and R^2. In all models we are controlling for contextual determinants.

Model 1. Political & institutional determinants. This model includes political and policy determinants only.

Model 2. Organizational & managerial determinants. This model includes organizational and managerial determinants only.

Model 3. Political & institutional and organizational & managerial determinants. This model combines models 1 and 3, including both political and policy determinants and also organizational and managerial determinants. This model is based on Cresswell and Pardo's (2001) argument on the importance of convergence between legal/policy and organizational aspects to influence the success of a digital government project.

Model 4. Information and technology determinants. This model includes information and technology determinants only.

Model 5. Full model of determinants. This model combines all determinants as depicted in Fig. 1 (policy and political, managerial and organizational, and technology and information) that may influence the success of an interagency information sharing project.

4. Analysis and results

Based on a review of the previous literature, this study presents a theoretical model that includes variables that have been identified as influencing the success of inter-organizational information sharing initiatives. Our regression analysis provides empirical quantitative evidence for a few of these important relationships. This section shows the main results from our analyses and starts discussing their implications.

Table 2
Descriptive statistics of the variables.

Explanatory variables		Mean	SD
Success of the inter-organizational information sharing initiative	[SUC]	5.78	1.43
Regulatory framework	[RG]	$4.79e^{-09}$	1.36
Executive involvement	[EI]	$-3.90e^{-09}$	1.29
Enabling legislation	[EL]	3.11	2.24
Support from legislature	[SL]	3.64	1.98
Diversity of participating organization	[DO]	5.56	1.62
Nature of Incentives	[NIC]	3.99	2.45
Network governance structure	[NG]	5.12	1.75
Hierarchical governance structure	[HG]	2.17	1.85
Formally assigned initiative manager	[PM]	5.56	1.49
Availability of financial resources	[FR]	4.56	1.63
The use of external consultant	[EC]	3.98	2.37
Interoperable standard	[IOS]	5.33	1.85
Technical infrastructure	[TCI]	4.74	1.57
Information security	[ISE]	5.58	1.97

The pairwise correlation matrix presented in Table 3 merits analytical attention before we present the regression results. Table 3 indicates that variables related to political and policy determinants, organizational determinants, and technological determinants all significantly correlate to the success of the inter-organizational information sharing initiative. The existence of a regulatory framework (0.23), executive involvement (0.35), and support of the legislature (0.18) have positive and significant correlation to the success of information sharing initiatives. As expected, the availability of financial resources (0.45) and formally appointed project managers (0.41) are also correlated with the success of the initiative. Table 3 also shows that three technological factors—interoperable standards (0.33), technical infrastructure (0.43), and information security (0.17)—are all significantly correlated with the success of inter-organizational information sharing initiatives. Given that the average correlation coefficient is around 0.39, the results indicate that executive involvement (0.35), the availability of financial resources (0.45), formally appointed project managers (0.41), interoperable standards (0.33), and technical infrastructure (0.43) are positively correlated with the success of the initiative. For instance, about 20% of the variation in the success of initiatives might be explained by the availability of financial resources.

To test whether the independent significant relationship of each factor persists when considering the combined effect of all factors and their respective unique variance, we ran robust multivariate regression analysis to mitigate the issue of heteroscedasticity (Table 4). Consistent with the theoretical model developed from previous studies, Table 4 presents the regression results for five statistical models. Three models, political and policy (model 1), organizational (model 2), and technological (model 4), regress each category of the success determinants of information sharing initiative individually. Model 3 assesses whether the impact of policy persists with the inclusion of organizational factors. Finally, model 5 measures the influence of organizational, policy, and technology determinants when combined together in one single regression model.

4.1. Model 1: Political and institutional variables as determinants of the success of inter-organizational information sharing initiatives

When only considering the political and policy aspects, the results in model 1 indicate that executive involvement emerges as a significant predictor of inter-organizational information sharing success with a coefficient of 0.32 (t-value: 2.52; p-value: 0.013), controlling for the other

[4] The four components are: interoperable architecture; trusted social network; shared information; and integrated data (see Gil-Garcia et al., 2010).

[5] See Cresswell and Pardo (2001) for the argument to test the convergence between legal and organizational in understanding digital government success.

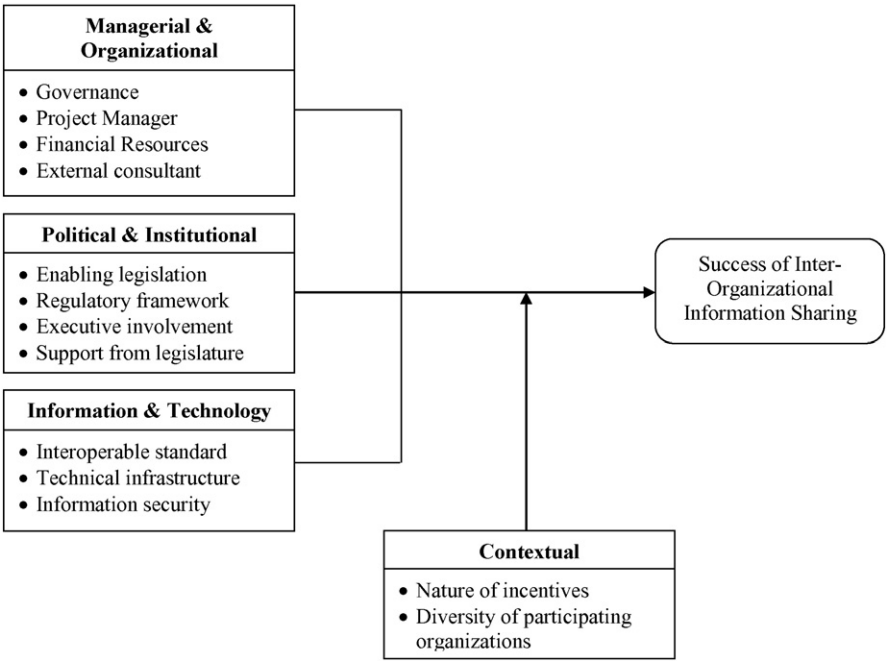

Fig. 1. Research model.

variables included in the model. Executive involvement is necessary to induce and/or strengthen institutional legitimacy. The executive provides sponsorship from a recognized authority for the inter-organizational collaboration (Dawes & Prefontaine, 2003), as well as ensuring support for the resources necessary for the collaboration. Table 4 also shows that other institutional predictors—the regulatory framework, enabling legislation, and support from the legislature—are not statistically significant. We argue that this could be due to the nature of the incentives influencing the pursuit of inter-organizational information sharing initiatives. However, this finding deserves additional research.

The descriptive statistics indicate that 52% of respondents stated that the initiative did not begin as a result of special events such as new legislation, a crisis, or an election. Thus, we could infer that many of the initiatives were enacted as part of a general strategy on behalf of the agencies involved and not due to special events. On the other hand, the R^2 of model 1 is only 0.11, indicating that the variables included in the model only explain 11% of the variation in the dependent variable. This result clearly shows that there are other important variables that can further explain the variation and that are not included in this first model.

4.2. Model 2: Organizational and managerial variables as determinants of the success of inter-organizational information sharing initiatives

We also examine the influence of organizational and managerial variables on the success of inter-organizational information sharing. Model 2 tests the influence of the governance structure (network and hierarchical), formally assigned project managers, and the availability of financial resources on the success of inter-organizational information sharing. The results indicate that two predictors—the project manager (coefficient: 0.35; t-value: 3.58; p-value: 0.000) and availability of financial resources (coefficient: 0.29; t-value: 3.88; p-value: 0.000)—significantly explain the success of inter-organizational information sharing initiatives. The results also indicate that the existence of external consultants is not a significant predictor.

We argue that the existence of formally assigned project managers contributes to making coordination of the inter-organizational sharing

Table 3
Pairwise correlation matrix.

	RG	EI	NIC	EL	SL	DO	NG	HG	PM	FR	EC	IOS	TCI	ISE	SUC
RG	1.00														
EI	**0.30**	1.00													
NIC	0.09	−0.02	1.00												
EL	**0.36**	0.06	**0.23**	1.00											
SL	**0.34**	**0.19**	**0.33**	**0.28**	1.00										
DO	**0.21**	**0.20**	0.09	**0.23**	0.06	1.00									
NG	0.14	**0.19**	0.02	0.01	0.09	0.08	1.00								
HG	**0.26**	0.12	**0.25**	0.14	**0.41**	0.08	**−0.16**	1.00							
PM	**0.36**	**0.36**	−0.06	**0.19**	**0.23**	**0.18**	**0.18**	**0.17**	1.00						
FR	0.10	**0.30**	0.11	0.07	**0.19**	0.04	−0.01	0.12	**0.24**	1.00					
EC	**0.16**	**0.27**	−0.03	0.05	**0.20**	**0.16**	**0.19**	0.10	**0.28**	0.09	1.00				
IOS	**0.47**	**0.35**	0.07	**0.16**	**0.35**	0.14	0.14	**0.21**	**0.36**	**0.17**	**0.35**	1.00			
TCI	0.12	**0.24**	−0.09	−0.02	0.06	0.05	**0.18**	0.07	**0.23**	**0.36**	**0.22**	**0.17**	1.00		
ISE	**0.19**	0.09	0.03	0.10	0.06	**0.18**	0.03	0.06	**0.22**	0.03	**0.25**	**0.25**	0.07	1.00	
SUC	**0.23**	**0.35**	0.03	0.13	**0.18**	0.12	0.14	0.06	**0.45**	**0.41**	0.12	**0.33**	**0.43**	**0.17**	1.00

Note: Numbers in bold indicate significance at 0.05 level or lower.

Table 4
Multivariate Ordinary Least Squares Regressions.

	Political & policy model [Model 1]	Organizational perspective [Model 2]	Policy and organization [Model 3]	Technological perspective [Model 4]	Combined model [Model 5]	
					β	Standardized β
Regulatory framework	0.090		0.040		− 0.050	− 0.046
	(0.10)		(0.08)		(0.08)	(0.08)
Executive involvement	0.320		0.138		0.106	0.097
	(0.13)*		(0.12)		(0.11)	(0.11)
Enabling legislation	0.040		0.024		0.036	0.056
	(0.05)		(0.05)		(0.04)	(0.04)
Support from legislature	0.060		0.026		0.020	0.029
	(0.05)		(0.05)		(0.05)	(0.05)
Network structure		0.060	0.043		0.008	0.009
		(0.06)	(0.06)		(0.06)	(0.06)
Hierarchical structure		− 0.040	− 0.064		− 0.087	− 0.112
		(0.05)	(0.05)		(0.05)	(0.05)
Project manager		0.350	0.306		0.270	0.285
		(0.10)**	(0.09)**		(0.09)**	(0.09)**
Financial resources		0.290	0.270		0.168	0.189
		(0.08)**	(0.08)**		(0.07)*	(0.07)*
External consultant		− 0.011	− 0.024		− 0.084	− 0.139
		(0.05)	(0.05)		(0.05)	(0.05)
Interoperable standard				0.184	0.126	0.164
				(0.06)**	(0.06)*	(0.06)*
Technical infrastructure				0.364	0.284	0.312
				(0.07)**	(0.08)*	(0.08)*
Information security				0.060	0.053	0.073
				(0.05)	(0.05)	(0.05)
Nature of incentives	− 0.010	0.020	0.012		0.026	0.044
	(0.05)	(0.04)	(0.05)		(0.04)	(0.04)
Diversity of participants	0.010	0.028	0.008		0.000	0.000
	(0.08)	(0.06)	(0.07)		(0.07)	(0.07)
Constant	5.350	2.063	2.590	2.757	1.407	-
	(0.52)	(0.62)	(0.69)	(0.50)	(0.74)	
N	160	160	158	165	158	158
F_{value}	2.67	10.67	7.89	15.70	8.43	8.43
R^2	0.11	0.31	0.32	0.275	0.42	0.42

Notes:
( ) standard errors in parentheses
Model 3 combines Model 1 and 2
Model 5 combines Model 3 and 4
* significant at 0.05 level.
** significant at 0.01 level.

effort more efficient. Better coordination could be seen as a very important factor for the success of inter-organizational information sharing initiatives. The availability of financial resources is positive and significant for the success of the initiative. As expected, the availability of resources is needed to sustain the collaboration for the inter-organizational information sharing efforts and to move the initiative forward. The R^2 of model 2 is 0.31, indicating that the model explains about 31% of the variation in the dependent variable, which is clearly better than model 1. Model 3 combines the variables in model 1 and model 2 and the results are explained in the following section.

4.3. Model 3: Political, institutional, managerial, and organizational variables as determinants of the success of inter-organizational information sharing initiatives

As shown in Table 4, combining policy and organizational variables did not increase the explanatory power of the model or change the significance of any of the predictors. The inclusion of organizational determinants renders executive involvement not significant (see model 3). On the other hand, the inclusion of political and policy determinants did not change the explanatory power of formally assigned project managers (coefficient: 0.306; t-value: 3.31; p-value: 0.000) and availability of financial resources (coefficient: 0.270; t-value: 3.40; p-value: 0.000); both are still positive and significant (see model 3). It seems that the impact of political and policy variables may develop longitudinally and their influence could be partially or fully mediated by organizational variables.

In addition, information sharing is seen by the respondents as part of their day to day operations. Survey results indicate that more than 60% of the initiatives are at the local government level and more than 50% of the respondents are from local governments (see Table 1). Consequently, an analysis of longitudinal data might provide better understanding of the impact of policy and political determinants. As mentioned before, executive involvement lost its significance in this third model, which could be because just over half of the respondents (52%) regarded their initiatives as part of a more general strategy of the agencies. Thus, the role of the executives is not as crucial as the formally assigned project managers and the availability of financial resources. More specifically, it could be the case that once the initiative formally assigns a project manager and secures enough financial resources, the importance of executive support diminishes, which could be also seen as a mediation effect between executive involvement and the success of inter-organizational information sharing initiatives.

4.4. Model 4: Technology and information variables as determinants of the success of inter-organizational information sharing initiatives

In model 4, we tested the impact of information and technology variables in influencing the success of inter-organizational information sharing initiatives. The results in Table 4 indicate that the existence of standards (coefficient: 0.184; t-value: 3.05; p-value: 0.001) and

compatible technical infrastructure (coefficient: 0.364; t-value: 4.90; p-value: 0.000) significantly influence the success of inter-organizational information sharing initiatives. This result is consistent with previous studies that assert the importance of interoperable standards and technological infrastructure compatibility (Bekkers, 2009; Ferro & Sorrentino, 2010; Gil-Garcia & Pardo, 2005a, 2005b; Gottschalk, 2009). The R^2 of model 4 is 0.275, indicating that the model explains about 27.5% of the variation in the dependent variable.

4.5. Model 5: An integrative model: political, policy, managerial, organizational, information, and technology variables as determinants of the success of inter-organizational information sharing initiatives

In model 5, we tested the impact of all the different proposed variables in explaining the success of inter-organizational information sharing initiatives. The results in model 5 are clearly consistent with the results from model 2 and model 4. There are four variables that emerge as significant predictors of the success of inter-organizational information sharing initiatives. These variables are: formally assigned project managers (coefficient: 0.270; t-value: 3.10; p-value: 0.002), availability of financial resources (coefficient: 0.168; t-value: 2.24; p-value 0.05), interoperable standards (coefficient: 0.126; t-value: 1.95; p-value: 0.05), and technical infrastructure (coefficient: 0.284; t-value: 3.58; p-value: 0.000). We also calculate the standardized (beta) coefficients to enable comparison among the variables in terms of their relative impact on the dependent variable. The beta coefficients for the four significant predictors, in order of importance, are: 0.312 for compatible technical infrastructure, 0.285 for formally assigned project managers, 0.189 for availability of financial resources, and 0.164 for interoperable technical standards.

4.6. The role of contextual determinants: nature of incentives and diversity of participating agencies

The analysis indicates that the two contextual variables—the nature of incentives and diversity of participating organizations—are not statistically significant predictors of inter-organizational information sharing success. As mentioned before, this result might be due to the distribution of the level of government among survey respondents who coordinate the inter-organizational information sharing initiative and the nature of the initiative's boundary. The majority (56%) of the initiatives' primary coordinators are from local governments.

Arguably, the complexity of the local-level initiatives the survey respondents describe may have less diversity of participating organizations than multi-national initiatives. It could also be the case that the context affects other determinants, but does not have a direct influence on inter-organizational information sharing (a mediation effect). An additional possibility is that the context does not directly affect the success of inter-organizational information sharing, but influences the strength of the relationship between other factors and the success of these initiatives (an interaction effect). However, these are just possible explanations and we intend to analyze the role of these and other contextual factors in the success of inter-organizational information sharing initiatives as part of our future research agenda.

5. Discussion of key findings

In this study, we tested five different statistical models to evaluate the determinants of success in government inter-organizational information sharing initiatives. From these five models, the analysis of the results indicates four factors as the key determinants.

Political and policy factors in the form of regulations or formal agreements about the initiative, existing legislation that made the initiative possible, and legislators supporting the initiative are not found to be statistically significant for the success of inter-organizational information sharing initiatives. This finding is consistent with previous research such as the study by Gil-Garcia et al. (2007), which found that political barriers did not significantly affect the expectation of benefits from users. The roles and influences of political context are also multidimensional and vary based on specific cases. For instance, in the case of Qatar's e-service implementation, El-Haddadeh et al. (2013) argue that the political context has both positive and negative impacts on funding and on creating regulations that govern the usage of the implemented initiatives.

In our case, we argue that the respondents consider information sharing initiatives as part of day-to-day government operations and not an effort to fulfill political interests as represented by elected officials. In fact, more than half (52%) of respondents stated the initiatives were not a consequence of special events or circumstances. Therefore, these initiatives were enacted as part of the general strategy of the agencies, such as improving operational efficiency, and thus were not seen as being directly affected by political appointees or legislators.

In addition, as part of normal government operations in the eyes of the respondents, the initiatives were also not significantly affected by legislation, regulations, or specific agreements. Consequently, political and policy factors were seen as less important than organizational and technological factors. Political factors, in the results from our case, could be more implicit, but still influence the commitment to providing the necessary resources and funding for the initiatives at their outset. Additionally, it is also plausible to argue that political factors have an implicit role in governing the usage and stewardship of the shared information and data through information policy. These propositions are avenues for further research to ascertain the mediated role of political factors in affecting inter-organizational information sharing success.

As expected, the results indicate that the availability of financial resources is crucial for the success of government inter-organizational information sharing initiatives. Gharawi and Dawes (2010) argue that the lack of financial support can be one of the clearest reasons for failure in inter-organizational information sharing initiatives. Financial resources are important for initiating and sustaining collaboration in inter-organizational projects (Gharawi & Dawes, 2010). Our findings provide evidence to support their argument and showcase that availability of financial resources contributes to the success of inter-organizational information sharing initiatives. We also found the role of formally assigned project managers to be statistically significant, but we did not find the governance structure to be a significant predictor of the success of inter-organizational information sharing initiatives.

Inter-organizational information sharing initiatives often rely on collaborative work involving various managers or personnel from diverse organizations performing different roles at different times. In addition to their roles in the collaborative work, these managers and other staff members still need to devote the majority of their time to their day-to-day work within the organization. According to Agranoff (2006), typically public managers only spend 15–20% of their total work time in collaborative work. Considering the complexities of collaboration and the availability of managers' and other personnels' time, the existence of formally assigned project managers is crucial to sustain and make the collaboration successful.

This finding seems to align with Hulstijn et al. (2011), who argue that project managers hold important roles in balancing the need for flexibility and providing governance to diverse participating organizations. However, this result could also be related to the fact that the governance structure was found not to be a statistically significant predictor. One explanation for this lack of significance could be that the formally assigned project manager would do the hard work to sustain the collaboration regardless of the governance structure of the information sharing initiatives. The governance structure might be more important when the initiative does not have formally assigned project managers.

We found technical interoperability to be an important factor for the success of inter-organizational information sharing initiatives, particularly the compatibility of technical infrastructure and the use of

technical standards. These findings are consistent and support several previous studies—such as Bekkers (2009); Ferro and Sorrentino (2010); Gil-Garcia and Pardo (2005a, 2005b); Gottschalk (2009); McDermott (2010); Pardo et al. (2004); Pardo and Tayi (2007); and Scholl and Klischewski (2007), among others—that postulate the substantial roles of technical compatibility and interoperability in the form of standards, metadata, platforms, and applications for the success of inter-organizational information sharing initiatives.

According to Sanderson et al. (2015), standardization in methods and metadata for interoperability are crucial for ensuring the compatibility of heterogeneous and disparate data sources to improve access to shared information and data. As argued by Janssen and Cresswell (2005), in the public sector context the importance of standards is imperative during the implementation and integration of various technologies.

As mentioned earlier, we also compared the relative importance of the four significant predictors: formally assigned project managers, availability of financial resources, interoperability standards, and technical infrastructure. The standardized coefficient of these variables indicates that the compatibility of technical infrastructure seems to be more important than other variables. The formally appointed project manager variable emerges as the second most important determinant in the analysis. This finding further supports our argument that the respondents consider information sharing initiatives as part of government operations and perhaps part of strategic initiatives, but not in the political sphere. Therefore, the variables related to government operations and the project itself, in terms of actors necessary to sustain and move the initiative forward and the compatibility of legacy technical infrastructure, are regarded as crucial predictors for the success of these initiatives. In addition, this finding also suggests that there might be different determinants influencing the success of the initiatives depending on the nature of the incentives underlying the initiation of the project. Future research should explore these potential differences in other contexts.

6. Concluding remarks

This section presents the main contributions of this study to the theory and practice of inter-organizational information sharing. The section is divided into three sub-sections. First, we present the contributions to theory, particularly the quantitative test of the variables and the evidence generated about the ones that are statistically significant. Second, we argue that there are some practical lessons that could be derived from this study and applied to the management of inter-organizational information sharing initiatives. Finally, we explain some of the limitations of this study.

Overall, the results of the analysis indicate four key factors—formally assigned project managers, availability of financial resources, interoperable standards, and compatible technical infrastructure—as determinants of inter-organizational information sharing success. The standardized coefficient of these variables further indicates that the compatibility of technical infrastructure seems to be more important than other variables, while the variable "formally assigned project managers" is the second most important determinant.

6.1. Contributions to theory

Our study contributes to understanding the determinants of success of inter-organizational information sharing initiatives, and particularly the critical role of formally assigned project managers in supporting and nurturing the efforts. The existence and statistical significance of a set of organizational and technological factors—project managers, financial resources, compatible technology infrastructure, and interoperable standards—shows the impact of these variables on the successful implementation of inter-organizational information sharing initiatives. Our finding of the significant role of formally assigned project managers supports and complements the results found in previous studies, such as Huxham and Vangen (2000) and McGuire (2006). In the Huxham and Vangen (2000) study, they argued that leadership is often assigned from outside the control of the members of the collaboration. As such, they argued that leadership is often imposed upon the collaboration through structure and process. In addition, they posit that acting as a leader for collaborative work such as inter-organizational information sharing is highly resource consuming and requires significant personal attention.

Such attention and efforts are often lacking in the members of a collaborative, particularly public managers who need to spend 80–85% of their total work time in their routine organizational tasks (Agranoff, 2006). Our findings thus highlight the importance of formally assigned project managers as a key actor to initiate and sustain the inter-organizational information sharing collaboration amidst a complex environment. This finding points to an opportunity for further development of this research in the formative stages of collaboration, focusing on the emergence of project managers and their role in sustaining and managing inter-organizational information sharing collaboration efforts. It is also important to clarify that some of these variables had already been identified in the literature, but quantitative explorations are still scarce. Another contribution of this study is to provide evidence for the generalization of the effect of certain variables, which could be thought of as important in many other inter-organizational information sharing initiatives, but further research is needed.

6.2. Contributions to practice

Using the case study approach, previous studies have recognized technical incompatibility, lack of political support, and lack of financial resources among the major challenges to implementing inter-organizational information sharing initiatives. Our research provides the quantitative empirical support for these key determinants. In particular, this study underscores the significance of the role of project managers when implementing inter-organizational information sharing. Our findings provide potential guidance for the developers and managers of inter-organizational information sharing initiatives about the key factors to consider in planning, structuring, and managing the collaboration efforts.

The assignment of project managers dedicated to the initiative is likely an important first step in the collaboration. Securing adequate financial resources is clearly valuable to the success of inter-organizational information sharing initiatives. While funding is important for any project, it is even more important for collaborative efforts, since they will likely falter without the human and financial resources necessary to keep them moving forward. Finally, it is clear that information sharing is not possible without the necessary technical infrastructure and the use of interoperable technical standards. Organizations that want to share information need technical ways to implement this goal and obtain greater benefits from the collaboration. Although some of these recommendations might seem obvious, this study provides evidence about their importance and potential for generalizability, which make them more powerful as guidance for public managers.

6.3. Limitation and future research

The findings presented here are predominantly based on a national survey conducted in the US and, therefore, the results do not necessarily apply to other national realities. However, since our study contributes to the understanding of the determinants of inter-organizational information sharing initiatives success, the hypotheses proposed in this study could be applied and tested using data from other countries. Such comparison could further ascertain the generalizability of the findings.

In addition, this study employs ordinary least squares regression to infer the findings on the determinants of interagency information sharing success. This technique is sufficient to analyze direct relationships

between a dependent variable and multiple independent variables, yet insufficient to account for the possible inter-relationships and interdependence among the determinants (independent variables). As we argued in the discussion section, there might be an indirect relationship between political contexts and the success of inter-organizational information sharing that is mediated, for instance, by the availability of funding, governance of usage, and stewardship of information. Future research could further explore these possible recursive and indirect relationships among the variables by employing other techniques such as covariance-based structural equation modeling, partial least squares, or system dynamics.

Dawes (1996) argues that the complexity of information sharing projects develops in layers in which a smaller nucleus (composed of interpersonal relations) affects and is affected by the larger layers. Yang and Maxwell (2011) further argue that there are intricate relationships between interpersonal, intra-organizational, and inter-organizational levels in cross boundary information sharing. This study did not take into account these layers of intricacies and only focuses on the inter-organizational aspects. Aside from a potential problem of endogeneity, the existing survey data did not capture the interrelationships among the layers. Thus, we propose that future research should test some of the interrelationships between interpersonal, intra-, and inter-organizational level variables.

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Djoko Sigit Sayogo is senior lecturer in the Department of Economics and Business at the University of Muhammadiyah at Malang (UMM), Indonesia. Additionally, Djoko is the Director at the Center for Economics, Business and Entrepreneurships Development at the Department of Economics, University of Muhammadiyah at Malang. He is currently a Postdoctoral Associate at the Center for Technology in Government. He was working on the CTG team that aims to develop a proof of concept for global information systems using Semantic Web technologies based on OWL ontology, called I-Choose. He is a former Fulbright Presidential Scholar from Indonesia.

J. Ramon Gil-Garcia is an Associate Professor of Public Administration and Policy and the Research Director of the Center for Technology in Government, University at Albany, State University of New York (SUNY). Dr. Gil-Garcia is a member of the Mexican National System of Researchers and of the Mexican Academy of Sciences. In 2009, he was considered the most prolific author in the field of digital government research worldwide and in 2013 he was selected for the Research Award, which is "the highest distinction given annually by the Mexican Academy of Sciences to outstanding young researchers." Currently, he is a Faculty Affiliate at the National Center for Digital Government, University of Massachusetts Amherst and also an Affiliated Faculty member of the Informatics Doctorate Program at the College of Engineering and Applies Sciences, University at Albany. He is also a Professor (on leave) in the Department of Public Administration at *Centro de Investigación y Docencia Económicas (CIDE)* in Mexico City. Dr. Gil-Garcia is the author or co-author of articles in prestigious international journals in Public Administration, Information Systems, and Digital Government and some of his publications are among the most cited in the field of digital government research worldwide. His research interests include collaborative electronic government, inter-organizational information integration, smart cities and smart governments, adoption and implementation of emergent technologies, digital divide policies, new public management, public policy evaluation, and multi-method research approaches.